Olfactory system in pigeons responds to magnetic stimulation

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Many birds sense geomagnetic fields and may use them for navigation. However, experimental manipulation of magnetic perception and studying flights over magnetic anomalies has indicated a moderate role of magnetoperception in homing of pigeons and navigation of albatrosses. On the contrary, destruction or inactivation of the olfactory system of pigeons has detrimental effects on homing performance, indicating a multimodal integrating role of this circuitry. If so, one would expect a subpopulation of neurons in the olfactory system to respond to magnetic stimulation. We have exposed 18 freely moving pigeons for 30 min to magnetic field alternating 0.16 to 1.87 G, delivered by a rotating neodymium magnet. Brains were investigated for neurons expressing the immediate early gene ZENK, a marker of neuronal activity. Magnetic stimulation significantly increased numbers of ZENK-expressing neurons bilaterally in both the olfactory bulb (40%) and the olfactory cortex (61.5%), but also in the hippocampus, in the hyper- and mesopallium, and caudolateral nidopallium. At present we do not know whether the olfactory bulb or cortex is magnetosensitive or whether they receive centrifugal input from other magnetosensitive structures. Regardless of this, our study corroborates an essential role of the olfactory system for navigation.

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